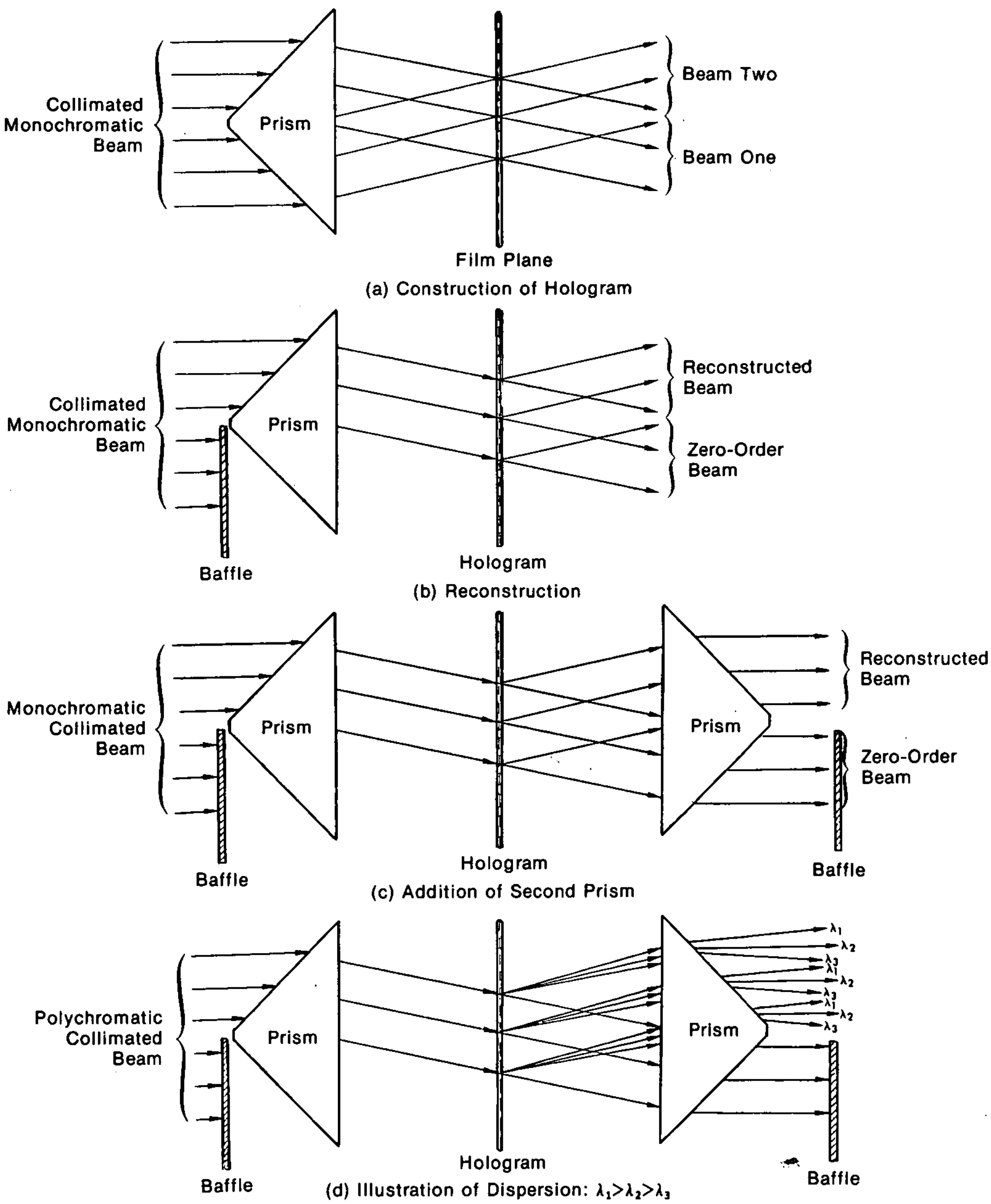
NASA TECH BRIEF

Langley Research Center

Holographic Direct-Vision Spectroscope



Combined Prisms and Holographic Grating for Direct-Vision Spectroscope

(continued overleaf)

A simple direct-vision spectroscope has been designed and tested at Langley Research Center. The spectroscope incorporates two prisms combined with a holographic grating as the dispersing element. This provides high dispersion with a selective undeviated wavelength.

The operation of the holographic direct-vision spectroscope is best understood by examining the construction of the holographic grating (see illustration). A collimated monochromatic beam, incident on the two faces of the prism, is split into two beams which cross at the film plane (a). A high-resolution film plate is placed in the film plane to record the interference pattern. The spacing between the lines is simply the wavelength of the light divided by twice the sine of half the angle between the two beams.

The film is developed and placed back in its original position. The lower face of the prism is blocked, and a collimated beam incident on the upper face of the prism is refracted by the prism, producing only one beam (b). This beam is partially diffracted by the holographic grating, forming two beams. The zero-order beam is the attenuated beam passing straight through the hologram while the reconstructed beam is formed by the diffracted energy. These beams are directly analogous to beams one and two (a).

A second prism is added as shown (c). Collimated light, having the same wavelength as the construction light, will have entering, reconstructed, and zero-order beams which are parallel. The entering and reconstructed beams are collinear.

If the entering light is not monochromatic or is not of the same wavelength as the light used for construction, the reconstructed beam or beams will not be collinear with the entrance beam but will be dispersed about it according to wavelength (d). Shorter wavelengths will be diffracted less and longer wavelengths will be diffracted more than the wavelength of construction. The exit angle of the zero-order beam is independent of wavelength. The amount of dispersion is dependent on the line spacing of the holographic grating. The line spacing is dependent on the angles and the index of refraction of the prism used for construction.

The undeviated wavelength is the same as the construction wavelength if the construction and reconstruction prisms are identical. Construction is easiest with laser light as it is characteristically monochromatic and coherent. For wavelengths for which lasers are not available, several alternate schemes of construction may be used separately or combined. Prisms with different indices of refraction and/or angles for construction and reconstruction may be used. Also, different prisms for the input and the output may be used.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Langley Research Center
Mail Stop 139-A
Hampton, Virginia 23665
Reference: B75-10090

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
Langley Research Center
Mail Stop 313
Hampton, Virginia 23665

Source: John M. Franke
Langley Research Center
(LAR-11750)

Categories: 03 (Physical Sciences)
04 (Materials)